PTS 2000 *Version 4.0*

User's Manual

PURITAN
BENNETT

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Definitions

This manual uses the following special indicators to convey information of a specific nature:

Warning

Indicates a condition that can endanger operator or service person.

Caution

Indicates a condition that can damage the equipment.

NOTE:

Indicates points of particular emphasis that make operation of the *PTS 2000*™ more efficient or convenient.

Warnings, cautions, and notes

Please take the time to familiarize yourself with the following safety considerations, special handling requirements, and regulations that govern the use of the Performance Test System *PTS 2000*.

Warning

Possible explosion hazard if used in the presence of flammable anesthetics.

Warning

ELECTRICAL SHOCK HAZARD: Only qualified and trained personnel are authorized to service the *PTS 2000* or replace the unit's O_2 sensor. Use only factory-approved parts and procedures to service this instrument. Contact Puritan Bennett service personnel for further information.

Caution

Be sure the inlet and exhaust ports are not obstructed, and any connecting hoses are not kinked. Obstructing ports and hoses can cause inaccurate readings.

Caution

Always use dry gas; humidified gas will affect the accuracy of flow measurements.

Caution

Always use the *Re/Flex* or *D/Flex* filter assembly (or equivalent) in-line in the high-flow inlet hose; if the filter is not used correctly, performance can be impaired.

Caution

Always cap the flowmeter inlets and outlets when the instrument is transported or not in use.

Warning

Grounding reliability can be achieved only when the equipment is connected to a receptacle marked "HOSPITAL GRADE."

Serialization

The *PTS 2000* test instrument has a unique serial number that is used to track calibration dates and identify the unit's year of manufacture.

Customer assistance

For further assistance contact your local Puritan Bennett representative.

Preface

This manual provides information needed to operate the Performance Test System *PTS 2000* and is intended for use by certified biomedical engineering technicians or personnel with equivalent experience and training in using this type of equipment.

The O_2 sensor is the only field replaceable unit (FRU) on the *PTS 2000*; all additional service requirements, including system calibration, must be performed by the manufacturer.

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PTS 2000 overview

1.1 Introduction

The Performance Test System *PTS 2000* (Figure 1-1) is a test instrument manufactured for Puritan-Bennett Corporation. It is used with respiratory care products to measure performance parameters, such as:

- air, oxygen, and nitrous oxide flows

- air and oxygen volumes

- oxygen concentration

- gauge and barometric pressure

- peak flow and peak pressure

- various breathing parameters

The *PTS 2000* is a stand-alone test instrument with an embedded firmware operating program. It can also be used with a personal computer (PC) to run the Puritan Bennett *BreathLab PTS*™ software programs to troubleshoot respiratory systems and to perform ventilator field performance tests.

Figure 1-1. *PTS 2000* test instrument

1.2 Hardware overview

The *PTS 2000*, shown in Figure 1-2, is a small, lightweight, portable test instrument with a carrying handle and four feet. A tilt-up bail, located on the front of the unit, allows the user a broad range of visibility and can be folded flush to the case for storage or transporting purposes.

Figure 1-2. *PTS 2000* **portability**

The *PTS 2000* consists of a test instrument with a variety of accessories, shown in Figure 1-3 and defined in Table 1-1.

NOTE:

See Section 5 for specification and part number information.

Figure 1-3. *PTS 2000* **and accessories**

<div align="center">

Table 1-1: *PTS 2000* and accessories

</div>

Item	Description
PTS 2000	Test instrument
ac cord	10 foot (3M) cord with hospital grade plug
Power supply	External ac-to-dc power supply source
Re/Flex filter[1] Lo flow filter	Inlet filters used to protect internal sensors
RS-232 cable	Communication cable interfacing tester to personal computer
1/8-inch flow quick-connect coupling (female)	Mating connection to high pressure inlet port

1. The *Re/Flex* filter is a reusable filter. If a disposable filter is desired, use the *D/Flex* filter. See Section 5 for part number information.

NOTE: Maintain an assortment of connectors and hoses with the test equipment, for ease of connection to various devices.

1.2.1 Controls and ports

The *PTS 2000* controls and ports are located on the front and back panels. Each is clearly labeled for easy identification even when cords and hoses are attached.

1.2.2 Symbols and labels

Table 1-2 provides a list of the *PTS 2000* symbols and labels; Figure 1-4 and Figure 1-5 show their location on the unit.

Table 1-2: *PTS 2000* symbols and labels

Symbol	Meaning
▬▬▬	**Direct current** (dc) Refer to IEC 417
I O	**Power switch positions** per IEC 601-1 **I** position represents ON **O** position represents OFF
⚠	**Refer to manual** per IEC 601-1 Refer to *PTS 2000 User's Manual* for information.
SN	**Serial number label:** shown as bar code and numeric value
C E	CE marking of European Conformity for the Low Voltage Directive (LVD) and the Directive for Electromagnetic Compatibility (EMCD).
CSA® LR 58941 NRTL /C	North American safety approvals for Canada and the United States by the Canadian Standards Association (CSA) with the additional NRTL/C endorsement for the United States; Laboratory equipment IEC 1010-1. LR 58941.
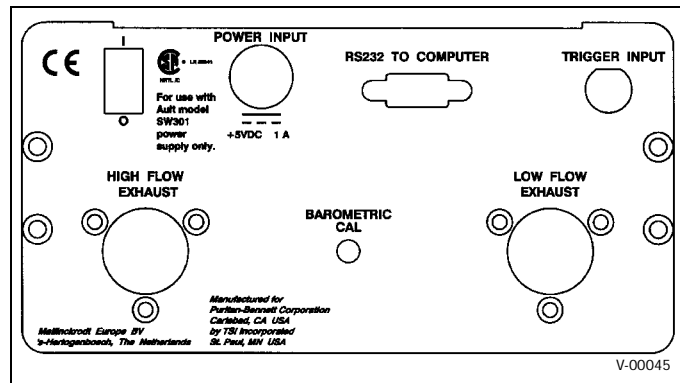
Figure 1-4. Back panel product label information

Figure 1-5. Location of *PTS 2000* symbols and labels

1.2.3 Front panel

Figure 1-6 shows the location of the front panel controls and ports.
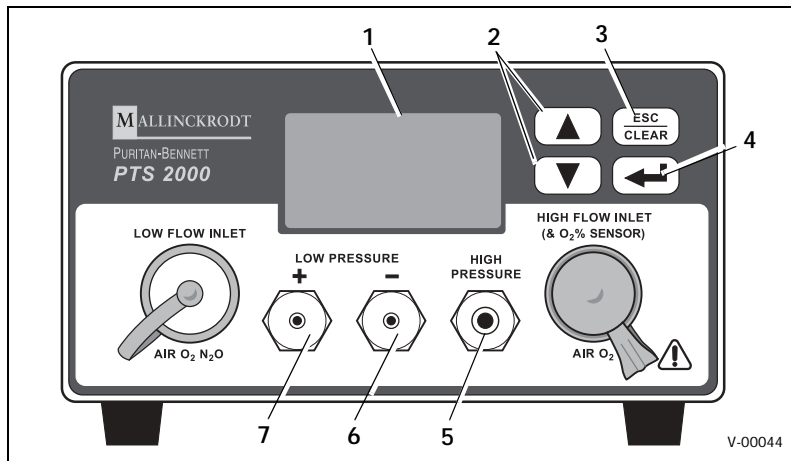
Figure 1-6. Front panel controls and ports

The following information provides the names and functions of the front panel features.

1. **LCD (Liquid Crystal Display)** screen: provides visual operator interface.

2. **UP** and **DOWN** arrow keys: allows operator to scroll through and select *PTS 2000* test parameters and units of measure. Also allows user to scroll through **AUXILIARY MENU** choices.

3. **ESC/CLEAR** key: allows operator to exit out of a mode, clear data values, and zero pressure transducers.

4. **ENTER** key: allows operator to activate edit mode of system, and step through active points on screen. It also allows user to select available parameters and units of measure.

5. **HIGH PRESSURE** (with quick disconnect coupling): port used to measure high pressure in pounds per square inch, gauge (psig); inches of mercury (inHg); and kilo Pascals (kPa).

6. **LOW PRESSURE** (–): port used to measure negative low pressure in cmH_2O (centimeters of water); mmHg (milimeters of mercury); inH_2O (inches of water); inHg (inches of mercury); and kPa (kilo Pascals).

7. **LOW PRESSURE** (+): port used to measure positive low pressure in cmH_2O (centimeters of water); mmHg (milimeters of mercury); inH_2O (inches of water); inHg (inches of mercury); and kPa (kilo Pascals).

Table 1-3 lists *PTS 2000* front panel controls and characteristics.

Table 1-3: Front panel controls and characteristics

Description	Size and Style
High flow meter inlet[1]	22mm barb connector
Low flow meter inlet	$^3/_{16}$-inch barb connector
Low pressure inlets (+/–)	$^1/_8$-inch barb connectors
High pressure inlet	$^1/_8$-inch flow quick-connect coupling
LCD screen	$2^1/_2$″ x $1^1/_4$″ (63.5 mm x 31.8 mm) area
Function select keys	Membrane switch w/graphic overlay

1. Contains O_2 sensor

Figure 1-7 shows the location of the high and low flow inlet ports. The following lists the functions of these ports:

Figure 1-7. **High flow and low flow inlet ports**

1. **HIGH FLOW** inlet port (with protective cap): measures high flow and volume for air and oxygen, or air/oxygen mix. Flow measurements can be displayed in liters per minute (lpm) or standard liters per minute (slpm). The high flow inlet port contains the O_2 sensor for measuring the oxygen content of a gas.

NOTE:

Standard default unit of measure appear as slpm. Other measurements of lpm (liters per minute), cfm (cubic feet per minute), and scfm (standard cubic feet per minute) may also be selected.

2. **LOW FLOW** inlet port (with protective cap): measures low flow for air, oxygen, and nitrous oxide. Default flow measurements are displayed as slpm. Other units of measure that can be selected are lpm, cfm, or scfm.

Caution

To protect the flow sensors from contamination and condensation when not in use, the protective caps should be fully seated over the high flow and low flow inlet ports.

1.2.4 Back panel

Figure 1-8 shows the *PTS 2000* back panel controls and ports.
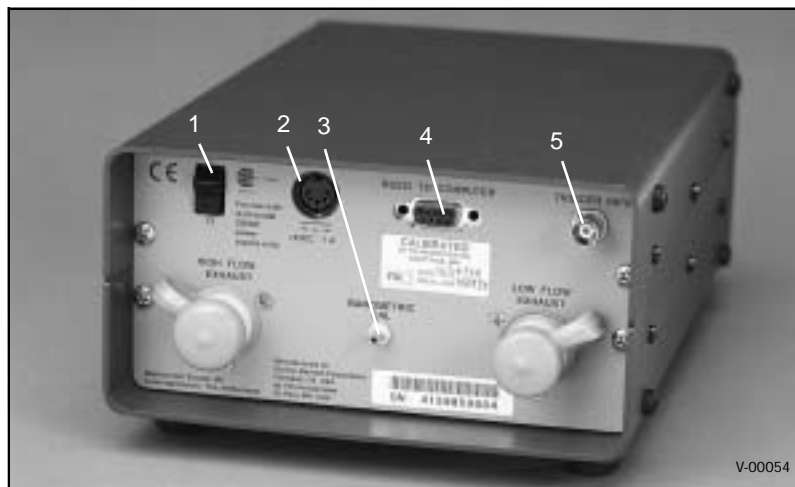
Figure 1-8. **Back panel controls and ports**

Their applicable function follows:

1. **ON/OFF SWITCH**: powers *PTS 2000* on and off.

2. **POWER INPUT**: connector for internal power supply dc power plug:

$$\overline{=}\,\overline{=}$$

+5 VDC 1A

3. **BAROMETRIC CAL**: port open to atmosphere for measuring barometric pressure. Default unit of measure is psia and optional units are mmHg, bar, mbar and atm.

Caution

The barometric port must always be open to atmosphere; any obstruction can damage the pressure sensors or result in an invalid reading.

---

4. **RS-232 to computer**: provides RS-232 communication interface between *PTS 2000* tester and PC.

5. **TRIGGER INPUT**: provides interface to a transistor-transistor logic (TTL) compatible signal source.

Figure 1-9 shows the location of the high and low flow
exhaust ports.

Figure 1-9. High and low flow exhaust ports

1. **HIGH FLOW EXHAUST**: exhaust port for the high flow inlet
   (shown with protective cap off).
2. **LOW FLOW EXHAUST**: exhaust port for low flow inlet
   (shown with protective cap off).

Caution

To protect flow sensors from contamination and
condensation when not in use, the protective caps should be
fully seated over the high flow and low flow exhaust ports.

Table 1-4 provides a list of the back panel controls
and characteristics.

Table 1-4: Back panel controls and characteristics

Description	Size and Style
High and low flow exhaust ports	22mm barb connector
Barometric calibration port	$^1/_8$-inch barb connector
RS-232 communication port	9-pin D-sub connector, female
Power ON/OFF switch	Rocker
Power input plug	5-pin female
Trigger input connector	BNC plug

1.2.5 Filters

Because *PTS 2000* flow sensors are susceptible to contamination and condensation, two reusable filters are provided with the *PTS 2000:* the *Re/Flex* filter is installed in-line with the high flow inlet port, and the low flow input filter is installed in-line with the low flow inlet port. These filters eliminate contaminants from the gas flow before it passes through the flow transducers.

The reusable *Re/Flex* filter is designed for repeated autoclaving, while the *D/Flex* filter must be discarded after use. Both filters have barbed connections at both ends and require a silicone coupling at the output port which connects to the tester. An arrow on the top each filter indicates air flow direction.

These components are identified in Figure 1-10.

1. *Re/Flex* filter

2. *D/Flex* filter

3. low flow filter

4. couplings
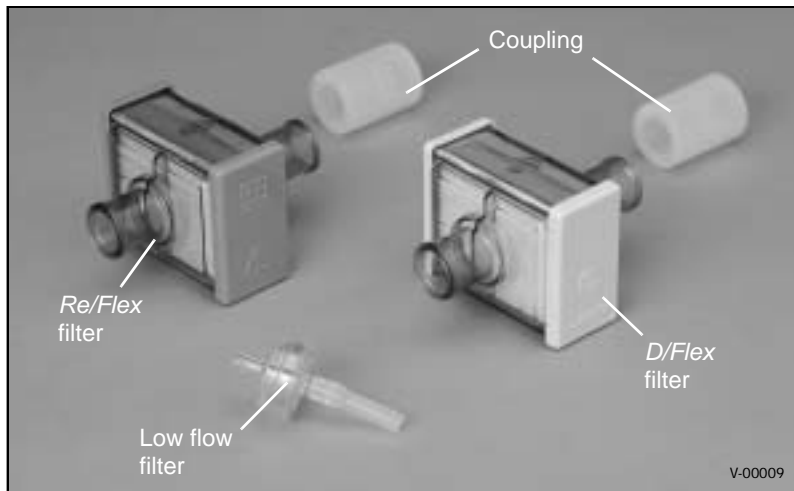
Figure 1-10. *PTS 2000* **filters and couplings**

• To ensure flow sensor accuracy and prevent tester
   contamination, it is mandatory that the above described
   input filters (or equivalent) be installed in-line with the
   high-flow and low-flow input ports as shown in
   Figure 1-11.

Caution

• When high and low inlet/exhaust ports are not in use,
   fit protective caps over the ports to protect from
   outside contaminates.

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Figure 1-11. *PTS 2000* **input filters**

1.2.6 Operational controls

The power switch, located on the back panel, is labeled with the international icons: **I** (ON) and **O** (OFF).

NOTE:

Each time the *PTS 2000* power switch is turned off and on, the pressure transducers are automatically reset, setting the baseline to zero. (For additional information see Section 4.)

The **ENTER** key, located on the front panel, provides access to the standard test functions on the *PTS 2000* as a stand-alone test instrument and permits the user to edit those items.

1.2.7 Cleaning

Clean exterior surfaces of *PTS 2000* and power supply with a clean cloth using isopropyl alcohol, hydrogen peroxide (3%), or ammonia (15%).

Do not spray cleaner or pour liquids on tester or
power supply.

1.3 Electrical connections

The *PTS 2000* electrically interfaces to an external dc power
supply unit (Figure 1-12). The RS-232 connection provides a
communication interface between the *PTS 2000* and a PC to run
the Puritan Bennett ventilator performance test software. (See
applicable software manual.) The RS-232 interface is used with
the trigger input to provide data acquisition capabilities.

The *PTS 2000* is designed for use *only* with the power supply
provided. Do not attempt to operate the *PTS 2000* using any
other power source.

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Figure 1-12. Power supply unit

Setup and operation

2.1 *PTS 2000* setup

This section describes how to set up the *PTS 2000* tester, including connecting inlet filters and hoses, exhaust hoses, and communication interface cables.

Warning

Position all hoses and wires so they do not present a hazard to the people working around them or interfere with the operation of the tester and the device being tested.

2.1.1 Front panel connections

The *PTS 2000* inlet connections are located on the front panel, as shown in Figure 2-1. These include:

1. low flow filter

2. *Re/Flex* filter

3. coupling

Follow the procedures below for instructions on installing the inlet filters and tubing.

1. Place *PTS 2000* on a flat, stable surface where it is safe from accidental impact.

2. Pull down tilt-up bail to position unit for viewing ease.

3. If necessary, slide coupling over outlet port of the *Re/Flex* filter (Figure 2-1).

NOTE:

- The *Re/Flex filter*, provided with the *PTS 2000,* is a reusable item designed for multiple autoclavings.
- The optional *D/Flex* filter is disposable and must be discarded after use.
- The arrow on the top of the *Re/Flex* and *D/Flex* filters indicates the direction of gas flow into the tester.
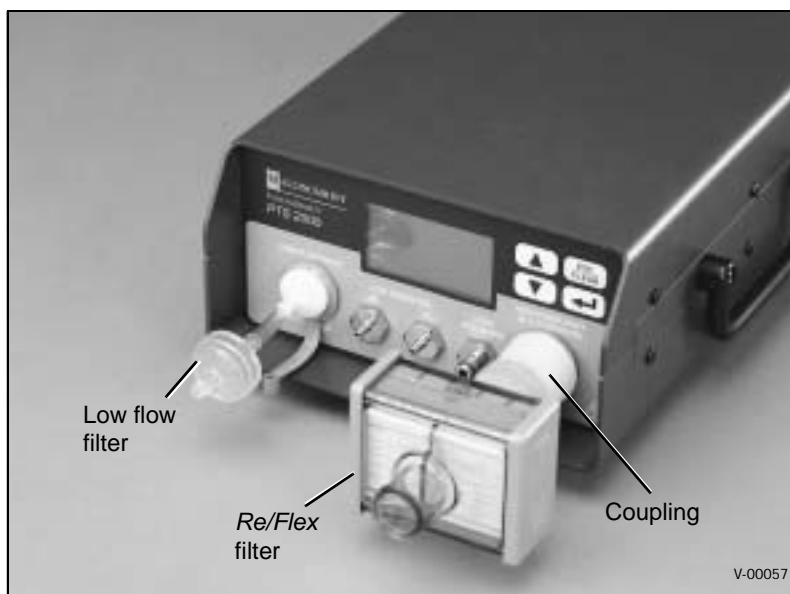
Figure 2-1. *PTS 2000* **inlet filters**

4. Remove protective cap from high flow inlet port.

5. Install *Re/Flex* filter by sliding the filter's output port (with coupling) over tester's high flow inlet port. Press firmly for a snug fit.

6. Remove protective cap from low flow inlet port.

7. Install low flow filter by sliding the filter's output port over tester's low flow inlet port. Press firmly.

8. Connect the following hoses as needed from device being tested to *PTS 2000* inlet ports (Figure 2-2):

   a. High flow tube in-line with *Re/Flex* filter (installed on high flow inlet port).

   b. High pressure tube to quick-connect coupling on high pressure port.

   c. Low (positive) pressure tube to low pressure (+) port *or* low (negative) pressure tube to low pressure (-) port, but not both.

   d. Low flow tube in-line with low flow filter (installed on low flow inlet port).

Figure 2-2. Inlet tube connections

2.1.2 Back panel connections

The *PTS 2000* back panel contains the high and low flow exhaust ports, barometric calibration port, interface communication connectors, power plug, and power input switch as shown in Figure 1-8 and Figure 2-3.

Caution

The barometric port must always be open to atmosphere;
any obstruction can damage the pressure sensor or cause
incorrect readings.

1. Remove protective cap from high flow exhaust port.

2. For a low flow measurement, remove protective cap from
    low flow exhaust port.

3. If *PTS 2000* will be used with Puritan Bennett
    PC-based test software, make the following connections:

    a. Connect two-way RS-232 communication cable to RS-232
        interface port.

    b. Connect the one-way trigger input signal cable to the
        trigger input port if necessary.

    c. Connect the dc power output connector (from external
        power supply) into the power input receptacle.

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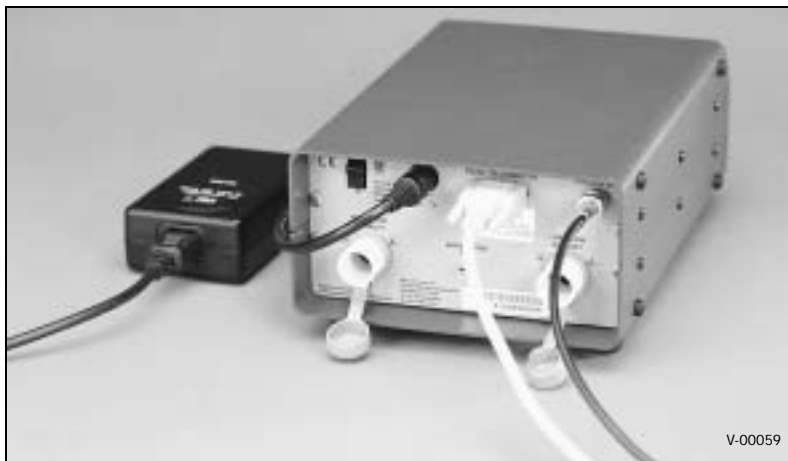
Figure 2-3. Back panel connections

4. Connect ac cord into dc power supply and wall outlet.

2.2 Operator interface

The *PTS 2000* operator interface includes the **ON/OFF** switch (located on the unit's rear panel); **UP** and **DOWN ARROW** keys; **ENTER** key; **ESC/CLEAR** key; and LCD message screen (Figure 2-4).

Figure 2-4. Operator keys LCD screen

2.3 Operational overview

The following overview details how the *PTS 2000* tester can be used as a stand-alone test instrument or in conjunction with a PC running the Respiratory Products Test Software program. The LCD message screen, shown above in Figure 2-4, is the operator interface, displaying *PTS 2000* system data, operator messages, test functions, and measurement data.

Once the *PTS 2000* is turned on and warmed up (as described below), the test functions can be accessed by pressing either the **UP** or **DOWN ARROW** keys or the **ENTER** key, to scroll through the tester functions. There are three modes of operation:

• **REMOTE OPERATION** mode is used in conjunction with *BreathLab PTS* software, using RS-232 interface. Appears as default screen at powerup. (See Figure 2-5.)

• **STAND-ALONE OPERATION** the tester takes measurements and displays results on LCD message window.

• **AUXILIARY SETUP MODE** provides access to *PTS 2000* diagnostic and oxygen sensor calibration functions.

2.4 Powerup and warmup

Figure 2-5. Powerup screen

1. Power up the *PTS 2000* by pressing the **ON/OFF** switch up. The LCD screen will display the following messages:

Revision x.x	Firmware revision number.
Calibration Date mm/dd/yyyy	Date *PTS 2000* was last calibrated. Example: 06/30/1999 represents June 30, 1999.
Recalibration Date	Next calibration due date. Example: 06/30/2000 represents June 30, 2000. (See Section 5 for calibration information.)

● ●

Caution

Do not use *PTS 2000* if unit has been dropped or if liquid penetrates unit. The unit must be returned to manufacturer for recalibration. See Section 5 for return procedure.

NOTE:

Each time the *PTS 2000* power switch is turned off and on, the pressure transducers are automatically zeroed.
Do not apply pressure to low or high pressure ports during powerup.

2. **Wait 10 minutes for tester to warm up, otherwise incorrect readings and measurements may result.**

NOTE:

If *PTS 2000* has not been maintained in an environment close to normal room temperature, allow additional time for warmup.

2.5 Tester functions

2.5.1 Parameters and screens

A total of 14 selectable parameters are available for acquiring test data and are displayed on nine default screens. Each screen displays one or two parameters that can be edited by the user. The tenth screen can be custom configured by the user to show preferred parameters and units of measure. An eleventh screen displays the **AUXILIARY MENU** mode. This menu is designated for accessing various diagnostic functions.

All screens can be accessed from the initial **REMOTE OPERATION** screen by pressing the **UP** or **DOWN ARROW** key.

The first 10 screens of selectable parameters are numbered. The number of the screen appears in the upper right-hand corner of the viewing area. The screen of the **AUXILIARY MENU** is not numbered. The 14 selectable parameters are:

- **HIGH FLOW**
- **PEAK HIGH FLOW**
- **LOW PRESSURE**
- **PEAK LOW PRESSURE**
- **VOLUME**
- **LOW FLOW**
- **HIGH PRESSURE**
- **BAROMETRIC**
- **% OXYGEN**
- **BREATH RATE**
- **I TIME**
- **E TIME**
- **I:E RATIO**
- **MINUTE VOLUME**

To change the parameters on a selected screen:

1. At the desired test screen, press **ENTER** key to edit items displayed. Measurement type at top of screen will flash.

2. Press **UP** or **DOWN** arrow key to scroll through available measurement choices.

NOTE:

The unit will not display duplicate parameters on a test screen.

3. Press **ENTER** key to accept measurement type.

4. Press **ENTER** key again to advance to next field
    or
    press **ESC/CLEAR** key to begin testing.

2.5.2 Trigger levels

The *PTS 2000* also provides 12 trigger levels that can be selected for **PEAK LOW PRESSURE, PEAK HIGH FLOW, BREATH RATE**, and **VOLUME**. Trigger levels include: 1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 35, 40 lpm.

To select a trigger level:

1. At desired test screen, press **ENTER** key to edit items displayed.

2. Press **ENTER** key once or twice to advance to trigger level for selected gas.

3. Press **UP** or **DOWN ARROW** key to scroll through available trigger levels.

4. Press **ENTER** key to accept preferred trigger level and advance to the next field
    or
    press **ESC/CLEAR** key to accept preferred trigger level and begin testing.

NOTE:

The trigger level is a global value. Changing it in one location on one test screen will change it in every location on all test screens.

2.5.3 Optional units of measure

There are optional units of measure for six test parameters. (Table 2-1) Section 6 provides definitions of these measurements.

Table 2-1: Optional units of measure

VOLUME	L	mL	ft^3		
HIGH FLOW	slpm	lpm	cfm		
LOW FLOW	slpm	lpm	cfm		
HIGH PRESSURE	psig	inHg	kPa		
LOW PRESSURE	cmH$_2$O	mmHg	inH$_2$O	inHg	kPa
BAROMETRIC	psia	mmHg	bar	mbar	atm

1. To select a unit of measure:

2. At the desired test screen, press **ENTER** key to begin editing. Measurement type at top of screen will flash. Press **ENTER** key until the unit of measure flashes.

3. Press **UP** or **DOWN ARROW** key to scroll through units of measure.

4. Press **ENTER** key to accept unit of measure and advance to the next field
    or
    press **ESC/CLEAR** key to accept unit of measure and begin testing.

2.5.4 Remote operation mode

Once the *PTS 2000* is turned on and warmed up, measurements can be performed. At the **REMOTE OPERATION** screen, default screens can be selected or test measurements can be charted on the PC using *BreathLab PTS*.

NOTE:

The **REMOTE OPERATION** mode requires RS-232 interface.

• •

1. To view the first default screen with preset parameters, press **UP ARROW** key. The number "1" will appear in the upper right hand corner.

2. Continue to press **UP ARROW** key to view all remaining screens.

The 14 selectable parameters include the following specifications and capabilities for testing.

2.5.4.1 High flow

The **HIGH FLOW** test function measures air, air/O_2 mixture and O_2.

Units of measure	slpm (default), lpm, cfm, scfm
Allowable range	0 - 300 slpm and lpm 0 - 10.595 cfm and scfm

1. To perform a high flow measurement, ensure the high flow air tube (from device being tested) is securely connected to high flow inlet port using *Re/Flex* filter (Figure 2-6) and the high flow exhaust port is open (protective cap removed).

2. Apply flow. The value displayed on the LCD screen is updated as flow changes. Record data when value stabilizes.

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Figure 2-6. High flow tube connection

2.5.4.2 Peak high flow

The **PEAK HIGH FLOW** test function measures air, air/O_2 mixture and O_2 peak flow during a breath cycle. Values are displayed at end of breath cycle. To perform the **PEAK HIGH FLOW** test, follow the steps listed previously for **HIGH FLOW**.

Units of measure	slpm (default), lpm, cfm, scfm
Allowable range	0 - 300 slpm and lpm 0 - 10.6 cfm and scfm

A trigger reading can be selected at the **PEAK HIGH FLOW** parameter. Once selected, the trigger value is applied to all trigger thresholds.

To select a trigger level:

1. At the **PEAK HIGH FLOW** parameter, press **ENTER** key three times.

2. Select one of 12 trigger levels by pressing **UP** or **DOWN ARROW** key.

3. Press **ESC/CLEAR** key to accept settings
   or
   press **ENTER** key to continue selecting other parameter options.

4. Once desired settings are established, press **ESC/CLEAR** key to begin testing.

2.5.4.3 Low pressure

The **LOW PRESSURE** test function measures negative and positive low pressures.

Units of measure	cmH_2O (default), kPa, inHg, inH_2O, mmHg
Allowable range	-150 to +150 cmH_2O

NOTE:

Before performing a low pressure measurement, the low pressure baseline should be reset. See Section 4.1.2.

1. To perform a *positive* low pressure measurement, ensure tube from device being tested is securely connected to low pressure (+) port (Figure 2-7). Disconnect any tubing from low pressure (-) port.

Figure 2-7. **Low pressure positive (+) tube connection**

2. Apply pressure. Value displayed on LCD is updated as positive pressure changes. Record data when value stabilizes.

3. To perform a negative low pressure measurement, ensure tube from device being tested is securely connected to low pressure (–) port (Figure 2-8). Disconnect any tubing from low pressure (+) port.

4. Apply pressure. Value displayed on LCD screen is updated as negative pressure changes.

Figure 2-8. Low pressure negative (-) tube connection

2.5.4.4 Peak low pressure

The **PEAK LOW PRESSURE** test function measures peak pressure during a breath cycle and displays measurements at the end of the breath cycle. Twelve trigger level options accompany this test function.

Units of measure	cmH$_2$O (default), kPa, inHg, inH$_2$O, mmHg
Allowable range	0 to +150 cmH$_2$O

1. Select **PEAK LOW PRESSURE** parameter on LCD screen. Ensure tube from device being tested is securely connected to low pressure (+) port. Disconnect any tubing from low pressure (-) port.

2. Apply pressure. Value displayed on LCD screen is updated at end of breath cycle.

3. With **PEAK LOW PRESSURE** test function selected as a parameter on LCD screen, press **ENTER** key until **PEAK LOW PRESSURE** parameter flashes.

4. Press **ENTER** key again; trigger level will begin flashing.

5. Press **UP** or **DOWN ARROW** key to select one of 12 trigger levels.

6. Press **ENTER** key to continue to edit other parameters or units of measure
   or
   press **ESC/CLEAR** key to begin testing.

2.5.4.5 Volume

The **VOLUME** test function measures air, air/O_2 mix, and O_2.

Units of measure	STP (default), ATP, BTBS
Allowable range	0 - 10 ATP, STP, BTPS Liters, 10,000 mL or 0.353 ft^3

1. To perform a volume measurement, ensure high flow air tube (from device being tested) is securely connected to high flow inlet port on *Re/Flex* filter (Figure 2-6), and high flow exhaust port is open (protective cap removed).

2. Apply flow. Value displayed on LCD is updated when trigger threshold is reached at end of breath cycle.

3. With **VOLUME** test function selected as parameter on LCD screen, press **ENTER** key until **VOLUME** parameter flashes.

4. Press **VOLUME** key again; trigger level will begin flashing.

5. Press **UP** or **DOWN ARROW** key to select one of 12 trigger levels.

6. Press **ENTER** key to continue to edit other parameters or units of measure
   or
   press **ESC/CLEAR** key to begin testing.

2.5.4.6 Low flow

This test function measures air, O_2, and N_2O low flow.

Units of measure	slpm (default), cfm, scfm, lpm
Allowable range	0 to +15 slpm

1. To perform a low flow air measurement, ensure low flow air tube (from device being tested) is securely connected to low flow inlet port using low filter (Figure 2-9) and low flow exhaust port is open (protective cap removed).

2. Apply flow. Value displayed on LCD screen is updated as flow changes.

3. Press **ENTER** key to change parameters, units of measure, trigger thresholds (if applicable), or gas
   or
   press **UP** or **DOWN ARROW** to change screen
   or
   ESC/CLEAR to return to data acquisition.

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Figure 2-9. Low flow tube connection

2.5.4.7 High pressure

The **HIGH PRESSURE** test function measures high pressure.

Units of measure	psig (default), kPa, inHg
Allowable range	0 to 100 psig

NOTE:

Before performing a high pressure measurement, the high pressure baseline should be reset. See Section 4.1.1.

1. To perform a high pressure measurement, ensure tube from device being tested is securely connected to quick-connect coupling on high pressure port (Figure 2-10).

2. Apply pressure. Value on LCD screen is updated as pressure changes.

3. Press **ENTER** key to edit parameters, units of measure, gas or trigger thresholds (if applicable), or gas
or
press **UP** or **DOWN ARROW** key to change screens
or
press **ESC/CLEAR** key to acquire test measures.

Figure 2-10. High pressure tube connection

2.5.4.8 Barometric

BAROMETRIC is an informational prompt only and displays the atmospheric barometric pressure.

Units of measure	psia (default), mmHg, atm, mbar, bar
Allowable range	10 to 16 psia

Press **ENTER** key to access next primary function.

2.5.4.9 Oxygen

The **OXYGEN** test function measures O_2 content of a gas at the high flow port.

NOTE:

Before taking an O_2 measurement, adjust the oxygen sensor gain to ensure an accurate oxygen measurement. See Section 3.1.1.

Allowable range	0 to 100%

1. To check O_2 content of a gas, ensure gas tube from device being tested is securely connected to **HIGH FLOW** inlet port on the *Re/Flex* filter (Figure 2-6) and the **HIGH FLOW** exhaust port is open (protective cap removed).

2. Apply gas flow. Value displayed on LCD screen is updated as oxygen concentration of gas changes. Allow at least one minute for concentration to stabilize before recording data.

2.5.4.10 Breath rate

BREATH RATE is an estimate of how many breaths would occur in the next minute based upon the duration of the current breath. This is calculated as such:

BREATH RATE = 60.0 seconds / (I Time seconds + E Time seconds)

1-BREATH = I TIME + E Time

To select a trigger level for **BREATH RATE** parameter, follow these steps.

1. With **BREATH RATE** parameter selected on LCD screen, press **ENTER** key until **BREATH RATE** parameter flashes.

2. Press **ENTER** key again; the trigger level will begin flashing.

3. Press **UP** or **DOWN ARROW** key to select one of 12 trigger levels.

4. Press **ENTER** key to continue to edit other parameters or units of measure
or
press **ESC/CLEAR** key to begin testing.

2.5.4.11 I time

I TIME represents Inspiratory Time. **I TIME** is the duration in seconds that the measure of **HIGH FLOW** is continually higher than the set threshold level. The starting point of **I TIME** is considered valid when at least 250 msec of **HIGH FLOW** data is measured above the threshold level. **I TIME** is measured in seconds (sec).

2.5.4.12 E time

E TIME is a shortened expression for Expiratory Time. **E TIME** is the duration in seconds that the measure of **HIGH FLOW** is continually less than, or equal to, the set threshold level. The starting point of **E TIME** is considered valid when at least 250 msec of **HIGH FLOW** data is measured equal to, or below, the threshold level. **E TIME** is measured in seconds (sec).

2.5.4.13 I:E ratio

The **I:E RATIO** is the proportion between Inspiratory Time and Expiratory Time where the larger is expressed as a multiple of the smaller.

When I Time > E Time (and E Time is non-zero), **I:E:RATIO=I TIME / E TIME**; format XX.X:1 or XXX:1.

When I Time=E Time (and non-zero), **I:E:RATIO=1.00:1**.

When E Time > I Time (and I Time is non-zero), **I:E:RATIO=E TIME / I TIME**; format 1:XX.X1 or 1:XXX

2.5.4.14 Minute volume

MINUTE VOLUME is an estimate of volume flow in the next minute based on the duration of a current breath. It is expressed as the following equation:

MINUTE VOLUME = VOLUME current x BREATH RATE current

MINUTE VOLUME has the same optional unit measures as VOLUME but has no selectable trigger levels.

2.5.5 Summary of tester functions and options

Table 2-2 summarizes the *PTS 2000* parameters, range and resolutions, gas types, trigger levels, units of measure, and applicable modes.

Table 2-2: Parameters - ranges, resolutions, and units

Parameter	Range and Resolution	Gas Type	Trigger	Units	Mode
Low Flow	0.000 to 15.000 slpm 0.0059 to 0.5297 scfm	Air, O_2, N_2O	N/A	lpm, slpm, cfm, scfm	N/A
High Flow	0.00 to 300.00 slpm 0.000 to 10.595 scfm	Air, O_2, Air/O_2	N/A	lpm, slpm, cfm, scfm	N/A
Peak High Flow	0.00 to 300.00 slpm 0.000 to 10.595 scfm	Air, O_2, Air/O_2	1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 35, 40 slpm	lpm, slpm, cfm, scfm	N/A
Volume	0.000 to 10.000 L STP 0 to 100000 mL STP 0.0000 to 0.3530 cf STP	Air, O_2, Air/O_2	1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 35, 40 slpm	L, mL, ft^3	STP, ATP, BTPS
Minute Volume	0.00 to 99.00 L STP 0 to 99000 mL STP 0.0000 to 3.4962 cf STP	Air, O_2, Air/O_2	N/A	L, mL, ft^3	STP, ATP, BTPS
Inspiratory Time	0.25 to 60.00 sec	N/A	N/A	sec	N/A
Expiratory Time	0.25 to 60.00 sec	N/A	N/A	sec	N/A
I:E Ratio	1:99.99 to 99.99:1 1:999.9 to 999.9:1	N/A	N/A	N/A	N/A
Breath Rate	0.0 to 150.0 bpm	N/A	1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 35, 40 slpm	bpm	N/A
Low Pressure	-150 to +150.00 cmH$_2$O -14.709 to +14.709 kPa -4.3437 to +4.3437 inHg -5.9055 to +5.9055 inH$_2$O -110.33 to +110.33 mmHg	N/A	N/A	cmH$_2$O, kPa, inHg, inH$_2$O, mmHg	N/A
Peak Low Pressure	-150 to +150.00 cmH$_2$O -14.709 to +14.709 kPa -4.3437 to +4.3437 inHg -5.9055 to +5.9055 inH$_2$O -110.33 to +110.33 mmHg	N/A	1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 35, 40 slpm	cmH$_2$O, kPa, inHg, inH$_2$O, mmHg	N/A

Table 2-2: Parameters - ranges, resolutions, and units (continued)

Parameter	Range and Resolution	Gas Type	Trigger	Units	Mode
High Pressure	0.00 to 100.00 psig 0.00 to 689.48 kPa 0.00 to 203.60 inHg	N/A	N/A	psig, kPa, inHg	N/A
Barometric Pressure	10.00 to 16.00 psia 0.680 to 1.088 atm 689 to 1103 mbar 0.689 to 1.103 bar 517.0 to 827.2 mmHg	N/A	N/A	psia, atm, mbar, bar, mmHg	N/A
Oxygen Concentra-tion	0.0 to 100.0 %O_2	N/A	N/A	%	N/A

Auxiliary menu

3.1 Purpose and functions

The **AUXILIARY MENU** is accessed via the **UP** or **DOWN ARROW** keys from the start-up screen. This menu provides edit options for units of measure, and provides access to a variety of diagnostic tests. Once accessed, five menu items will appear:

• **CALIBRATE OXYGEN**

• **FLOW COMPARE**

• **DEFAULT TESTS**

• **CLEAR ALL TESTS**

• **EDIT MODE ACCESS**

Press **ENTER** to activate **AUXILIARY MENU**. The active menu item will flash on LCD screen, and applicable test may be initiated. If another active menu item is desired, press **UP** or **DOWN ARROW** key.

3.1.1 Oxygen calibration

To calibrate 21% and 100% oxygen:

1. From **AUXILIARY MENU**, press **ENTER** key; active menu item will flash.

2. Select **CALIBRATE OXYGEN** (if not already flashing) with **UP** or **DOWN ARROW** key.

3. When **CALIBRATE OXYGEN** flashes, press **ENTER** key.

4. Press **ENTER** key again. The screen will display this message

```
          OXYGEN CALIBRATION

          Press ↵ to start.
          Press ESC to cancel.
```
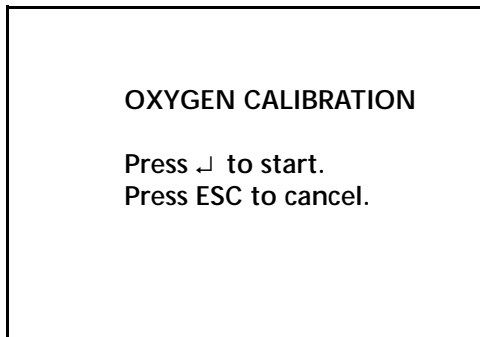
5. Attach hose with filter to **HIGH FLOW INLET**.

6. Apply 2 to 10 lpm of air flow.

7. Press **ENTER** key. A screen message will indicate *PTS 2000* is acquiring 21% air flow data within a 2 to 10 lpm range. If flow does not register within this range, a message to increase air flow will display.

NOTE:

There will be a delay until the *PTS 2000* registers a steady oxygen sensor reading. The screen will continue to display a message indicating that the unit is acquiring 21% O_2. Once this occurs, the *PTS 2000* will display a message **SEND 100% O2**.

---

8. Apply 2 to 10 lpm of 100% oxygen.

9. Press **ENTER** key to continue. Unit will display a message indicating that 100% O_2 data is being acquired. This will be followed by a message indicating whether calibration was successful by displaying either a **PASS** or **FAIL** message.

10. If unit displays a **PASS** message press **ENTER** key to indicate selection has been made and return to **AUXILIARY MENU**
or
if unit displays a **FAIL** message, repeat **OXYGEN CALIBRATION** procedure or contact Puritan Bennett service personnel for assistance.

3.1.2 Flow compare

The **FLOW COMPARE** function diagnoses the accuracy of high and low flow meters (which should agree within 5%). Flow compare result is an absolute value and does not identify which flow meter is faulty.

NOTE: When performing this test use filtered air only;
do not use oxygen.

---

1. From **AUXILIARY MENU**, press **ENTER** key.

2. Select **FLOW COMPARE** using **UP** or **DOWN ARROW** key.

3. Set flow reading to slpm.

4. Connect low flow air tube from device being tested to low flow inlet port using low flow filter (Figure 3-1).
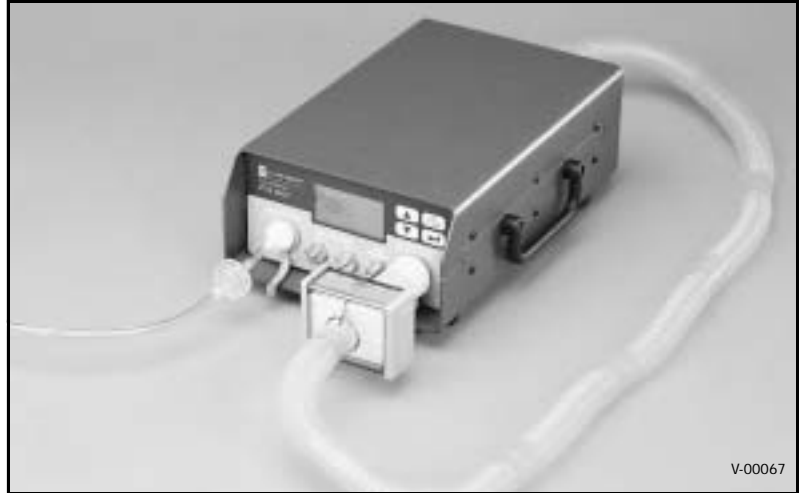

V-00067

Figure 3-1. Flow compare tube connections

5. Using a hose, connect one end of hose to **LOW FLOW** exhaust port on back panel of unit, and other end to **HIGH FLOW** inlet port on *RE/Flex* filter.

6. Apply 10 to 15 slpm of flow.

7. When the **FLOW COMPARE** menu item flashes, press **ENTER** key. Screen will display following information including **HIGH FLOW, LOW FLOW** and percent of difference as shown below.

```
FLOW COMPARE
High Low
x.xx slpm

Low Flow
x.xxx slpm
  xx % Error
```

8. Press **ESC/CLEAR** key at any time to return to **AUXILIARY MENU**. If another menu item is desired, press **UP** or **DOWN ARROW** key followed by **ENTER** key
   or,
   press **ESC/CLEAR** key again, followed by **UP** or **DOWN ARROW** keys to exit **AUXILIARY MENU.**

3.1.3 Default tests

1. From **AUXILIARY MENU**, press **ENTER** key.

2. Select **DEFAULT TESTS** menu item with **UP** or **DOWN ARROW** key.

3. When the **DEFAULT TESTS** menu item flashes, press **ENTER** key.

4. The screen will ask if you want to return to *PTS 2000* to factory defaults. Select **NO** or **YES** using **UP** or **DOWN ARROW** key and press **ENTER** key.

5. If you selected **YES**, a new screen will appear with this message: ARE YOU SURE? Select **YES** or **NO** using **UP** or **DOWN ARROW** key and press **ENTER** key.

6. If you are satisfied with all selections that you have made within the **AUXILIARY MENU** mode, press **ESC/CLEAR** key.

7. Press **ESC/CLEAR** key again to deactivate **AUXILIARY MENU**.

8. Press **UP** or **DOWN ARROW** key to advance to other screens and their respective displayed readings.

3.1.4 Clear all tests

The **CLEAR ALL TESTS** function clears all settings and acquired measurements and replace, with original test screens configured by the user. Three screens are available once **CLEAR ALL TESTS** function is selected:

• **REMOTE OPERATION** screen

• Screen that can be configured using operator's preferences

• **AUXILIARY MENU** screen

1. At **AUXILIARY MENU** select **CLEAR ALL TESTS** using **UP** or **DOWN ARROW** key.

2. When **CLEAR ALL TESTS** flashes, press **ENTER** key. The following message will appear:

```
CLEAR ALL TESTS

Delete all PTS 2000
test screens?


No
Yes
```
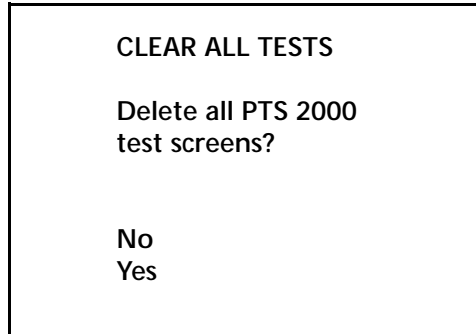
3. Select **YES** or **NO** using **UP** or **DOWN ARROW** key; selection will flash. Press **ENTER** key.

4. If **YES** was selected, the following message will appear.

```
CLEAR ALL TESTS

Are you sure?


No
Yes
```

5. Select YES or NO using UP or **DOWN ARROW** key; selection
    will flash. Press ENTER key. Unit will then return to
    AUXILIARY MENU.

3.1.5 Edit mode access

The **EDIT MODE ACCESS** function allows the user to establish and secure desired settings on various screens.

1. From **AUXILIARY MENU** select **EDIT MODE ACCESS** using **UP** or **DOWN ARROW** key.

2. When **EDIT MODE ACCESS** flashes, press **ENTER** key. The following message will appear:

```
EDIT ACCESS MODE

Allow user to edit
test screens?


No
Yes
```

3. Select **YES** or **NO** using **UP** or **DOWN ARROW** key; selection will flash.

4. Press **ENTER** key. Unit will return to **AUXILIARY MENU** screen.

5. Press **ESC/CLEAR** key and **UP** or **DOWN ARROW** key to resume testing and data acquisition.

Secondary functions

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4.1 Clearing data

This section provides instructions for clearing data entered into the *PTS 2000:* zeroing pressure transducers, clearing peak pressure values, and clearing breathing parameters.

4.1.1 Zero high pressure

The following steps describe how to zero the pressure transducer and reset the high pressure baseline to $0 \pm .1$ psig. This can be accomplished on any screen where the HIGH PRESSURE parameter is displayed.

NOTE:

Each time the *PTS 2000* power switch is turned off and on, the pressure transducers are automatically zeroed. Do not apply pressure to the low or high pressure ports during power up.

1. If necessary, disconnect high pressure tube from high pressure port on the *PTS 2000*. This removes any residual pressure.

2. To zero the pressure transducer, press ESC/CLEAR key. The high pressure baseline resets to zero (0).

4.1.2 Zero low pressure

The following steps describes how to zero the pressure transducer and reset the low pressure baseline to $0 \pm .4$.

NOTE:

Each time the *PTS 2000* power switch is turned off and on, the pressure transducers are automatically zeroed. Do not apply pressure to the low or high pressure ports during power up.

1. If necessary, disconnect low pressure tube from low pressure port on *PTS 2000*. This removes any residual pressure.

2. To zero the pressure transducer, press **ESC/CLEAR** key. The low pressure baseline resets to zero (0).

NOTE:

If pressure and breathing parameters or peak values are both displayed, pressure will be zeroed and values will be cleared.

4.1.3 Clearing breathing parameters and peak values

Breathing parameters and peak values are cleared in much the same way as zeroing pressure transducers. Press **ESC/CLEAR** key when the preferred parameter is displayed on the LCD screen. The LCD will display zeroes until that parameter is updated.

Calibration and specifications

5.1 *PTS 2000* calibration

PTS 2000 units are calibrated before shipment and are shipped with a Certificate of Calibration. A calibration label specifying the calibration date and the next calibration due date is located on the *PTS 2000* back panel. The certificate also shows the unit's model and serial numbers. Calibrations must be performed by the manufacturer. Section 5.2 instructs how to pack and ship the *PTS 2000*.

5.1.1 Certificate of calibration

Both new and recalibrated *PTS 2000* test instruments are delivered with a Certificate of Calibration which certifies that all materials, components, and workmanship, used in the manufacture of the instrument, are in strict accordance with all published specifications. The tests are based on standards and instrumentation whose accuracy is traceable to the National Institute of Standards and Technology (NIST).

All *PTS 2000* calibrations are performed by the manufacturer only. For recalibrations, return the unit as defined in Section 5.2.

Perform recalibration on the *PTS 2000* every 12 months. Recalibration is based on normal usage of four hours per day, five days per week, with a total of 1,040 operational hours per 12 months.

Caution

Do not use the *PTS 2000* if the unit has been dropped, or if liquid penetrates the unit.

NOTE:

> Operation at ambient pressures other than 14.7 psia may result in a false failure of the oxygen sensor.

5.1.2 Recalibration notification

When the *PTS 2000* is powered up, the LCD displays the last calibration date and the next recalibration due date.

5.2 *PTS 2000* return procedure

PTS 2000 units must be returned for recalibration and repairs, except for oxygen sensor replacement described in Section 7.1.

Contact Puritan Bennett technical services personnel for return information. A Puritan Bennett representative can also replace the oxygen sensor.

5.2.1 Repacking the *PTS 2000*

Each *PTS 2000* instrument comes packaged in a special shipping carton that complies with the requirements of ASTM D4169 standard. The carton is designed to be used twice: once to ship the unit to the customer, and again to return the unit for recalibration.

Figure 5-1 shows how to repack the *PTS 2000* in its original shipping carton for shipment.
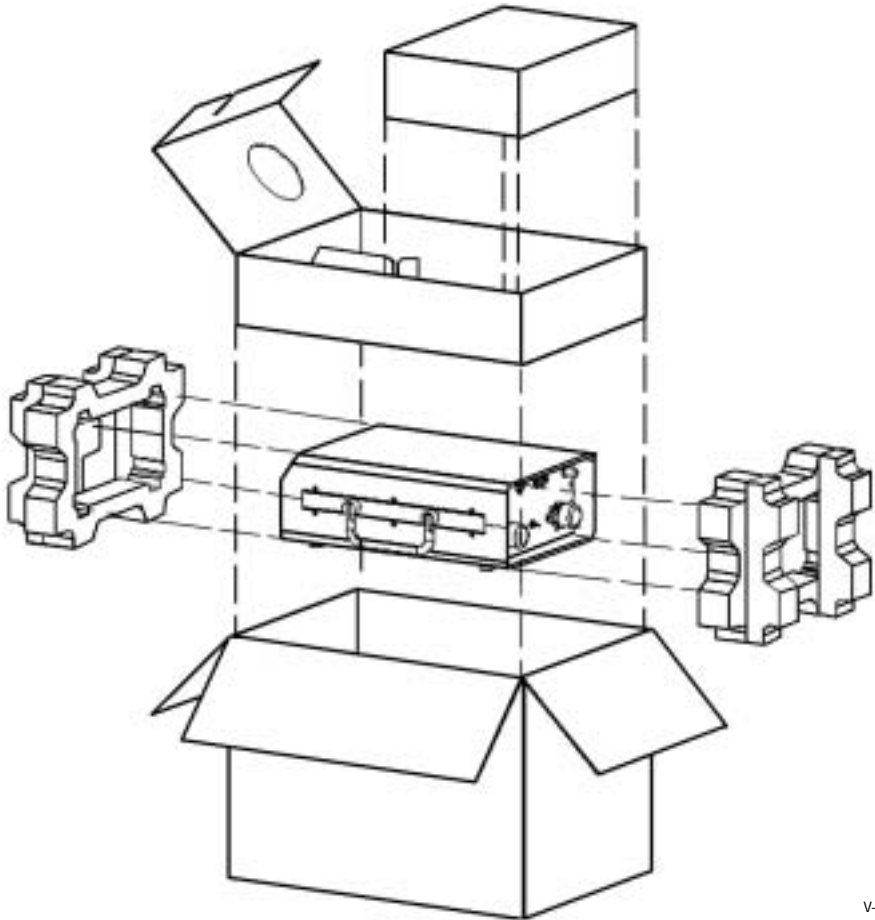
V-00068

Figure 5-1. Repacking the *PTS 2000*

5.3 *PTS 2000* parts list

Table 5-1 below lists the names and part numbers of the
PTS 2000 components.

Table 5-1: *PTS 2000* kit (4-076185-00)

Part Number	Qty	Description
N/A	1	Tester, *PTS 2000*
4-031324-00	1	Power cord[1]
4-074661-00	1	Power supply
N/A	1	Cable, RS-232, (10 feet)
4-074685-00	1	Shipping box, *PTS 2000* tester
4-074644-00	1	*Re/Flex* filter, barb (w/coupling)[2]
4-075303-00	1	Low flow filter
N/A	1	Certificate of Calibration
4-076180-00	1	*PTS 2000* User's Manual
N/A	1	$1/_8$-inch flow quick-connect coupling (female)

1.Country specific power cord voltages and P/Ns:
   4-031324-00 120V, 60Hz *(North America and Japan)*
   4-031320-00 240V *(Australia)*
   4-031321-00 220/230V, 50Hz *(Continental Europe)*
   4-031322-00 240V, 50Hz (fused) *(UK)*
   4-031323-00 220/230V, 50Hz *(Italy)*
   4-031325-00 220/230V, 50Hz *(Switzerland)*
2.The disposable *D/Flex* filter assembly P/Ns:
   4-074603-00 D/Flex filter, barb
   4-003443-00 Coupling
3.Optional accessories P/Ns available from Puritan Bennett
   4-076164-00 Carrying case
   4-072214-00 O_2 sensor

5.4 Electrical safety standards

When configured with its power supply, power cord, BNC cable for trigger input, and RS-232 interface cable for tester-PC communications, the *PTS 2000* system meets the following EMC and safety standards:

- Electromagnetic Interference or Emissions per EN55022, Class B (CISPR 22). FCC (CFR 47), Part 15.103(c) exempted device.

- Electromagnetic Susceptibility or Immunity per EN 50082-1:1997 which refers to IEC 1000-4-2, IEC 1000-4-3, 1000-4-4, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5 and ENV 50204.

- North American Safety approvals for Canada and the United States by the Canadian Standards Association (CSA) with the additional NRTL/C endorsement for the United States; Laboratory Equipment, IEC 1010-1.
  CSA file number LR 58941.

- International Electrotechnical Commission (IEC) System for Safety of Electrical Equipment CB Scheme Test Certificate issued by the National Certification Body; Laboratory Equipment, IEC 1010-1.

Table 5-2: *PTS 2000* Electrical Requirements

Specification	Range
ac input requirements for dc power supply	
Input voltage	100 to 250 Vac
Input frequency	50 to 60 Hz
Input connector	Standard IEC 320 connector, three-prong ac power socket
Output connector	Five-pin DIN 180 degree male connector
+5 Vdc output	5 Watts (1A) maximum

• •

5.5 Environmental specifications

Table 5-3: *PTS 2000* environmental specifications

Specification	Range
Operating temperature and humidity	+10 to +40 °C; 5 to 95% relative humidity, noncondensing
Storage temperature and humidity	-40 to +70 °C; 10 to 100% relative humidity, noncondensing
Operating altitude	-1,350 to 6,562 feet maximum
Storage altitude	50,000 feet maximum

5.6 Performance specifications

Table 5-4: *PTS 2000* performance specifications

Specification	Range
Low Flow (air and oxygen)	• Range 0 to 15 slpm • Accuracy (in slpm mode only) when operated within specified atmospheric pressure range and 15 to 25 °C $\pm$(1.75% of reading + 0.025 slpm). • Accuracy derating due to gas temperature: an additional error of $\pm$(0.1% of reading + 0.002 slpm) per 1 °C outside of 15 to 25 °C range.
Low Flow (nitrous oxide)	• Range 0 to 15 slpm • Accuracy (in slpm mode only) when operated within specified atmospheric pressure range and 15 to 25 °C: $\pm$(3.00% of reading + 0.025 slpm). • Accuracy derating due to gas temperature: an additional error of $\pm$(0.1% of reading +0.002 slpm) per 1°C outside of the 15 °C to 25 °C range.

Table 5-4: *PTS 2000* performance specifications (continued)

Specification	Range
High Flow and Peak High Flow (air or oxygen)	• Range 0 to 300 slpm • Accuracy (in slpm mode only) when operated within specified atmospheric pressure range and 15 to 25 °C: $\pm$(1.75% of reading + 0.10 slpm). • Accuracy derating due to gas temperature: an additional error of $\pm$(0.1% of reading + 0.004 slpm) per 1 °C outside of 15 to 25 °C range.
High Flow and Peak High Flow (air/oxygen mixture)	• Range 0 to 300 slpm • Accuracy (in slpm mode only) when operated within specified atmospheric pressure range and 15 to 25 °C: $\pm$(4.0% or reading + 0.10 slpm). • Accuracy derating due to gas temperature: an additional error of $\pm$(0.1% of reading + 0.004 slpm) per 1 °C outside of the 15 to 25 °C range.
Volume (air or oxygen)	• Range 0 to 10 STP liters • Trigger Threshold Range. Preselected 12 variables from 1 to 40 slpm. • Accuracy (in STP mode only) $\pm$2% of reading or 0.02 STP liter, whichever is greater (for peak flows less than 120 slpm). • Accuracy derating: an additional error of ±0.001 STP liter for every 6 slpm greater than 120 slpm (peak flow). Accuracy may degrade for volume times > 6 seconds.

Table 5-4: *PTS 2000* performance specifications (continued)

Specification	Range
Volume (air/oxygen mixture)	• Range 0 to 10 STP liters • Trigger Threshold Range. Preselected 12 variables from 1 to 40 slpm. • Accuracy (in STP mode only) ± 4.5% of reading or 0.02 STP liters, whichever is greater (for peak flows less than 120 slpm). • Accuracy derating: an additional error of ±0.001 STP liters per 6 slpm greater than 120 slpm (peak flow). Accuracy may degrade for volume times > 6 seconds.
Minute Volume (Air, Oxygen, and Air/Oxygen Mixture)	• Range 0 to 99 STP liters • Accuracy - Air or Oxygen: ± 7% • Accuracy - Air/Oxygen Mixture: ± 9%
I Time	• Range 0.25 to 60 seconds • Accuracy ± 0.01 seconds
E Time	• Range 0.25 to 60 seconds • Accuracy ± 0.01 seconds
I:E Ratio	• Range 1:999 to 999:1 • Accuracy ± 5%
Breath Rate	• Range 0.5 to 120 bpm • Accuracy ± 5%
Low Pressure	• Range -150 to 0 or 0 to +150 cmH$_2$O • Accuracy ±(0.75% of reading + 0.04 cmH$_2$O)
Peak Low Pressure	• Range 0 to +150 cmH$_2$O • Accuracy ±(0.75% of reading + 0.04 cmH$_2$O)
High Pressure	• Range 0 to +100 psig • Accuracy ±(1.0% of reading + 0.1 psig)
Atmospheric Pressure	• Range 10 to 16 psia • Accuracy ±0.1 psia

Table 5-4: *PTS 2000* performance specifications (continued)

Specification	Range
Oxygen Concentration	• Range 0 to 100% O_2 • Step response (0 to 90% of step change) 30 msec maximum (excluding transport time). • Accuracy $\pm 2\%$ O_2, when operating at the temperature and atmospheric pressure under which the oxygen sensor gain adjustment was performed.

NOTE:

Performance specifications are subject to change without notice and apply only to units that are used, maintained, and calibrated according to the procedures described in this manual.

5.7 United States FCC information

The equipment described in this manual generates and uses radio frequency (RF) energy. If the equipment is not installed and operated in strict accordance with the manufacturer's instructions, interference to radio and television reception may result.

This equipment complies with the requirements of CFR 47, Part 15 of the FCC Rules and its operation is subject to the following conditions:

• the equipment may not cause harmful interference, and

• the equipment must accept any interference received, including interference that may cause undesired operation.

Although the equipment has been tested and found to comply with allowed RF emission limits, as specified in the above-cited Rules, there is no guarantee that interference will not occur in a particular situation. Interference can be determined by switching the equipment off and on while monitoring radio or television reception.

The user may be able to eliminate any interference by implementing one or more of the following measures:

- reorient the affected device and/or its receiving antenna,

- increase the distance between the affected device and the computer equipment, and

- plug the computer and its peripherals into a different branch circuit from that used by the affected device.

While this device has been tested and found to be compliant to CFR 47, Part 15, Class B, it does not bear an FCC warning label as it is an exempted device as defined by CFR 47, Part 15.103 (c).

Caution

Only the manufacturer's cables or an equivalent double-shielded, host interface cable should be used with this equipment. Other types of cables may violate FCC rules and regulations. Also, changes or modifications to the electronics or enclosure of this product must be expressly approved by Puritan Bennett; otherwise, the user's authority to operate the equipment may be voided by the FCC.

5.8 Canadian DOC information

This apparatus does not exceed the Class B limits for radio noise emissions from digital devices as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Puritan-Bennett Corporation hereby certifies that the equipment referenced in this guide is in compliance with the requirements of CISPR 22, Class B.
Please observe the notices in the equipment instructions.

Glossary of terms

Term	Description
ac	alternating current
ATM	atmosphere
bar	bars
bpm	breaths per minute
cmH_2O	centimeters of water
cfm	cubic feet per minute
dc	direct current
ft^3	cubic feet
inH_2O	inches of water
inHg	inches of mercury
kPa	kilo pascals
LCD	liquid crystal display
L	liters
lpm	liters per minute
mbar	milibars
mL	mililiters
mmHg	mililiters of mercury
PC	personal computer
psig	pounds per square inch, gauge
psia	pounds per square inch, absolute
slpm	standard liters per minute (equivalent to 14.7 psia at 70° F or 21.1 ° C)

Term	Description
scfm	standard cubic feet per minute
$\%O_2$	percent oxygen concentration
ATP	actual temperature and barometric pressure
STP	standard temperature and pressure
BTPS	body temperature, barometric pressure, and saturated

Appendix

7.1 Replacing O$_2$ sensor

The oxygen sensor should be replaced every two years or as often as necessary. The sensor's life depends on the operating environment. The sensor's life span is reduced if used in an environment of higher temperatures or one that is oxygen rich. To change the oxygen sensor in the *PTS 2000* (version 4.0 firmware), follow these instructions:

1. Turn off power to *PTS 2000* and unplug from power source.

2. Remove six small screws that fasten top cover of *PTS 2000*. Lift off top cover.

3. Locate oxygen sensor.

NOTE:

O$_2$ sensor is located behind front panel as shown in Figure 7-1.

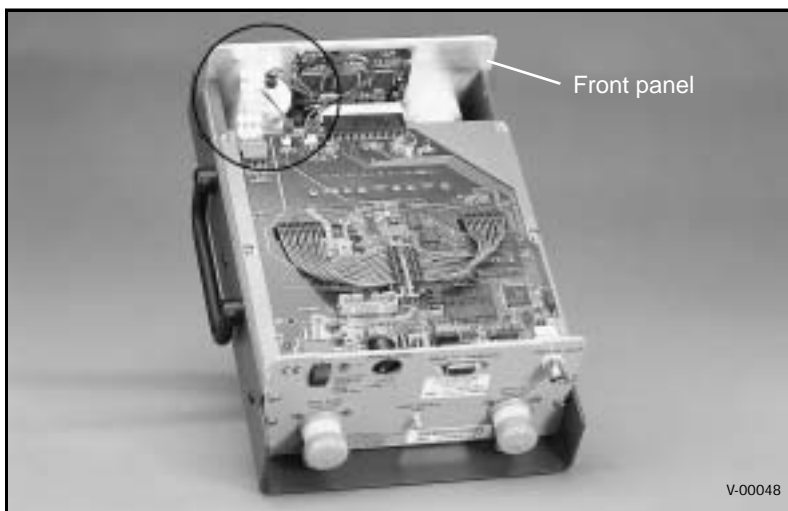4. Disconnect cable that connects sensor to PCB.

5. Unscrew sensor from manifold.

Front panel

V-00048

Figure 7-1. Location of oxygen sensor

6. **Install new oxygen sensor (Part Number 4-072214-00) and tighten until snug.**

Caution

When installing the O_2 sensor, do not overtighten. This could break the O-ring seal on sensor and cause high flow flowmeter to leak.

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7. **Reconnect cable to new oxygen sensor.**

8. **Replace top cover of *PTS 2000* and secure with six screws.**

9. **Calibrate new oxygen sensor described in Section 3.1.1 using *BreathLab PTS* software, (see *BreathLab Software User's Manual*).**